

09/914293  
518 Rec'd PCT/PTO 27 AUG 2001

PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of

Yuji FUJIMORI et al.

Application No.: U.S. National Stage of PCT/JP00/09241

Filed: August 27, 2001

Docket No.: 110443

For: SOLAR CELL AND SOLAR CELL UNIT

PRELIMINARY AMENDMENT

Director of the U.S. Patent and Trademark Office  
Washington, D. C. 20231

Sir:

Prior to initial examination, please amend the above-identified application as follows:

IN THE TITLE:

Please center the title as follows:

SOLAR CELL AND SOLAR CELL UNIT

IN THE ABSTRACT:

Please replace the Abstract filed with the attached Abstract hereto.

IN THE SPECIFICATION:

Page 1, line 1 is deleted.

Page 1, between lines 2 and 3, insert a new heading:

BACKGROUND OF THE INVENTION

Page 1, line 3, delete current heading and insert therefor:

1. Field of the Invention

09/914293-110443

Page 1, line 8, delete current heading and insert therefor:

2. Description of the Related Art

Page 2, line 26, delete current heading and insert therefor:

SUMMARY OF THE INVENTION

Page 9, line 21, delete current heading and insert therefor:

BRIEF DESCRIPTION OF THE DRAWINGS

Page 10, line 13, delete current heading and insert therefor:

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Please replace claims 1, 5-17, 23 and 25-30 as follows:

1. (Amended) A solar cell, comprising:

a pair of electrodes; and

a titanium dioxide semiconductor which is disposed between the electrodes,

the titanium dioxide semiconductor defining a surface and an interior, the surface and the interior of the titanium dioxide semiconductor being formed with pores, and the titanium dioxide semiconductor being arranged so as to form a rectification barrier with respect to at least one of the pair of electrodes.

5. (Amended) The solar cell as set forth in claim 1, wherein the electrode, with which said titanium dioxide semiconductor forms the rectification barrier, is formed in such a way as to penetrate into the surface of the titanium dioxide semiconductor and the interior thereof.

6. (Amended) The solar cell as set forth in claim 1, wherein said titanium dioxide semiconductor has a porosity of 5 to 90%.

7. (Amended) The solar cell as set forth in claim 1, wherein said titanium dioxide semiconductor has a porosity of 15 to 50%.

8. (Amended) The solar cell as set forth in claim 1, wherein said titanium dioxide semiconductor has a porosity of 20 to 40%.

9. (Amended) The solar cell as set forth in claim 1, wherein said titanium dioxide semiconductor is porous and has the fractal structure.

10. (Amended) The solar cell as set forth in claim 1, wherein the at least one of the pair of electrodes, with which said titanium dioxide semiconductor form the rectification barrier, is formed from a transparent electrode made of ITO, or a metallic electrode made of at least one metal selected from the group consisting of Al, Ni, Cr, Pt, Ag, Au, Cu, Mo, Ti, and Ta.

11. (Amended) The solar cell as set forth in claim 1, wherein the at least one of the pair of electrodes, with which said titanium dioxide semiconductor forms the rectification barrier, includes a solid iodide.

12. (Amended) The solar cell as set forth in claim 11, wherein the at least one of the pair of electrodes, with which said titanium dioxide semiconductor forms the rectification barrier, includes CuI (copper iodide).

13. (Amended) The solar cell as set forth in claim 11, wherein the at least one of the pair of electrodes, with which said titanium dioxide semiconductor forms the rectification barrier, includes AgI (silver iodide).

14. (Amended) The solar cell as set forth in claim 1, wherein the pair of electrodes are formed by vacuum evaporation.

15. (Amended) The solar cell as set forth in claim 1, wherein the pair of electrodes are formed by sputtering.

16. (Amended) The solar cell as set forth in claim 1, wherein the pair of electrodes are formed by printing.

17. (Amended) The solar cell as set forth in claim 1, wherein said titanium dioxide semiconductor is subjected to visual rays absorbable processing to enable absorption of visible rays.

23. (Amended) The solar cell as set forth in claim 17, wherein said titanium dioxide semiconductor includes impurities that include at least one of Cr and V.

25. (Amended) A solar cell unit, comprising:

a solar cell which includes a pair of electrodes, and a titanium dioxide semiconductor disposed between the pair of electrodes, the titanium dioxide semiconductor being formed with pores; and

first and second substrates, the solar cell being disposed between the first and second substrates.

26. (Amended) The solar cell unit as set forth in claim 25, wherein the first and second substrates are arranged so that solar rays enter from one side of one of the first and second substrates, the other substrate being arranged at a side of the one substrate that is opposite to the one side and being coated with a reflection film or having a reflection film thereon.

27. (Amended) The solar cell unit as set forth in claim 25, wherein the first substrate and the second substrate define a space therebetween, the space being filled with an inert gas including argon gas.

28. (Amended) The solar cell unit as set forth in claim 25, wherein at least one of the first and second substrates being arranged at a side from which solar rays enter, the at least one of the first and second substrates being formed into a transparent substrate or a translucent substrate formed of at least one of glass, plastic and synthetic resin.

29. (Amended) The solar cell unit as set forth in claim 25, wherein at least one of the first and second substrates is arranged at a side from which solar rays enter, the at least

one of the first and second substrates having a top surface and a bottom surface, and an anti-reflection film is coated or placed on at least one of the top surface and the bottom surface.

30. (Amended) The solar cell unit as set forth in claim 25, wherein at least one of the first and second substrates is arranged at the side from which solar rays enter, the at least one of the first and second substrates having a top surface, and a light catalyst made of titanium dioxide (TiO<sub>2</sub>) is coated on or placed on the top surface of the at least one of the first and second substrates.

REMARKS

Claims 1-30 are pending. By this Preliminary Amendment, the specification, abstract and claims 1, 5-17, 23 and 25-30 are amended. No new matter is added. Prompt and favorable examination on the merits is respectfully requested.

The attached Appendix includes marked-up copies of each rewritten paragraph (37 C.F.R. §1.121(b)(1)(iii)) and claim (37 C.F.R. §1.121(c)(1)(ii)).

Respectfully submitted,



James A. Oliff  
Registration No. 27,075

Eric D. Morehouse  
Registration No. 38,565

JAO:EDM/gam

Attachments:  
Substitute Abstract  
Appendix

Date: August 27, 2001

**OLIFF & BERRIDGE, PLC**  
P.O. Box 19928  
Alexandria, Virginia 22320  
Telephone: (703) 836-6400

DEPOSIT ACCOUNT USE AUTHORIZATION Please grant any extension necessary for entry; Charge any fee due to our Deposit Account No. 15-0461
--

094423-10501

# ABSTRACT

The solar cell of the present invention includes a titanium dioxide semiconductor that is held between a pair of electrodes so that the titanium dioxide semiconductor and at least one of the electrodes form a rectification barrier.

09014293, 110601

## APPENDIX

## Changes to Abstract:

The following is a marked-up version of the amended Abstract:

ABSTRACT

~~A conventional dye-sensitized solar cell is a wet cell employing an electrolyte such as an iodine solution or the like, it is necessary to seal the solar cell with a sealing compound or the like in order to contain the iodine solution therein. Therefore, there are many problems in that, for example, leakage of electrolyte solution occurs when the sealing is broken. Furthermore, when only a flat-shaped titanium electrode is used, current and voltage of practically required levels can not be secured because the absorption area of solar rays is small.~~ The solar cell of the present invention, ~~employing a porous titanium dioxide semiconductor, is characterized in that the~~ includes a titanium dioxide semiconductor that is held between a pair of electrodes so that the titanium dioxide semiconductor and at least one of the electrodes form a rectification barrier.

## Changes to Specification:

Page 1, line 1 is deleted.

~~TITLE OF THE INVENTION~~

Page 1, between lines 2 and 3, a new heading is added.

BACKGROUND OF THE INVENTION

Page 1, line 3:

1. Field of the Invention ~~FIELD OF THE INVENTION~~

Page 1, line 8:

2. Description of the Related Art~~BACKGROUND ART~~

Page 2, line 26:

DISCLOSURE OF THE INVENTION

SUMMARY OF THE INVENTION

Page 9, line 21:

BRIEF DESCRIPTION OF THE DRAWINGS

BRIEF DESCRIPTION OF THE DRAWINGS

Page 10, line 13:

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS~~BEST MODE FOR~~

PRACTICING THE INVENTION

Changes to Claims:

The following are marked-up versions of the amended claims:

1. (Amended) A solar cell, ~~employing a titanium dioxide semiconductor,~~  
comprising:
  - a pair of electrodes; and
  - a titanium dioxide semiconductor which is disposed between the electrodes,  
the titanium dioxide semiconductor defining a surface and an interior, the surface and the  
interior of the titanium dioxide semiconductor being formed with pores, and the titanium  
dioxide semiconductor being arranged so as to form a rectification barrier with respect to at  
least one of the pair of electrodes.
5. (Amended) The solar cell as set forth in ~~any one of~~ claims 1 ~~to~~ 4, wherein the  
electrode, with which said titanium dioxide semiconductor forms the rectification barrier, is  
formed in such a way as to penetrate into the surface of the titanium dioxide semiconductor  
and the interior thereof.



6. (Amended) The solar cell as set forth in ~~any one of claims 1 to 5~~, wherein said titanium dioxide semiconductor has a porosity of 5 to 90%.

7. (Amended) The solar cell as set forth in ~~any one of claims 1 to 5~~, wherein said titanium dioxide semiconductor has a porosity of 15 to 50%.

8. (Amended) The solar cell as set forth in ~~any one of claims 1 to 5~~, wherein said titanium dioxide semiconductor has a porosity of 20 to 40%.

9. (Amended) The solar cell as set forth in ~~any one of claims 1 to 8~~, wherein said titanium dioxide semiconductor is porous and has the fractal structure.

10. (Amended) The solar cell as set forth in ~~any one of claims 1 to 9~~, wherein the at least one of the pair of electrodes, with which said titanium dioxide semiconductor form the rectification barrier, is formed from a transparent electrode made of ITO ~~or the like~~, or a metallic electrode made of at least one metal selected from the group consisting of Al, Ni, Cr, Pt, Ag, Au, Cu, Mo, Ti, and Ta, ~~or a metal compound containing therein any one or more of these metals~~.

11. (Amended) The solar cell as set forth in ~~any one of claims 1 to 9~~, wherein the at least one of the pair of electrodes, with which said titanium dioxide semiconductor forms the rectification barrier, includes a solid iodide.

12. (Amended) The solar cell as set forth in claim 11, wherein the at least one of the pair of electrodes, with which said titanium dioxide semiconductor forms the rectification barrier, includes CuI (copper iodide).

13. (Amended) The solar cell as set forth in claim 11, wherein the at least one of the pair of electrodes, with which said titanium dioxide semiconductor forms the rectification barrier, includes AgI (silver iodide).

14. (Amended) The solar cell as set forth in ~~any one of claims 1 to 13~~, wherein the pair of electrodes are formed by vacuum evaporation.

15. (Amended) The solar cell as set forth in ~~any one of claims 1 to 13~~, wherein the pair of electrodes are formed by sputtering.

16. (Amended) The solar cell as set forth in ~~any one of claims 1 to 13~~, wherein the pair of electrodes are formed by printing.

17. (Amended) The solar cell as set forth in ~~any one of claims 1 to 16~~, wherein said titanium dioxide semiconductor is subjected to visual rays absorbable processing to enable absorption of visible rays.

23. (Amended) The solar cell as set forth in claim 17, wherein said titanium dioxide semiconductor includes impurities that include at least one of ~~such as~~ Cr and/or V.

25. (Amended) A solar cell unit ~~employing a titanium dioxide semiconductor~~, comprising:

a solar cell which includes a pair of electrodes, and a titanium dioxide semiconductor disposed between the pair of electrodes, the titanium dioxide semiconductor being formed with pores; and

first and second substrates, ~~which holds the solar cell~~ being disposed between the first and second substrates ~~therebetween~~.

26. (Amended) The solar cell unit as set forth in claim 25, wherein the first and second substrates are arranged so that solar rays enter from one ~~the~~ side of one of the first and second substrates, ~~in which the other substrate being arranged at a side of the one substrate that is opposite to the one side and being the opposite side is coated with a reflection film or having a reflection film thereon.~~

27. (Amended) The solar cell unit as set forth in claim 25 ~~or 26~~, wherein the ~~space between~~ the first substrate and the second substrate define a space therebetween, the space being ~~is~~ filled with an inert gas including ~~such as~~ argon gas.

28. (Amended) The solar cell unit as set forth in ~~any one of claims 25 to 27~~, wherein at least one of the first and second substrates being arranged at a side from which solar rays enter, the at least one of the first and second substrates being is formed into a transparent substrate or a translucent substrate formed of at least one of glass, plastic and ~~or~~ synthetic resin.

29. (Amended) The solar cell unit as set forth in ~~any one of claims 25 to 28~~ wherein at least one of the first and second substrates is arranged at a side from which solar rays enter, the at least one of the first and second substrates having has a top surface and a bottom surface, and an anti-reflection film is coated or placed on at least one of the top surface and the ~~or~~ bottom surface.

30. (Amended) The solar cell unit as set forth in ~~any one of claims 25 to 29~~ wherein at least one of the first and second substrates is arranged at the side from which solar rays enter, the at least one of the first and second substrates having has a top surface, and a light catalyst made of titanium dioxide (TiO<sub>2</sub>) is coated on or placed on the top surface of the at least one of the first and second substrates.